

# UNIVERSITY OF HAWAII

RG:0009

Environmental Center

Office of the Director

## ENVIRONMENTAL ASPECTS OF PROPOSED WASTEWATER TREATMENT PLANT AND RELATED FACILITIES WAILUKU-KAHULUI, MAUI

Statement for Environmental Protection Agency  
Public Hearing, 23 February 1973

By Doak C. Cox  
Director, University of Hawaii Environmental Center

The concerns of the University of Hawaii Environmental Center with the proposed wastewater treatment plant and related facilities deal with the environmental effects of its construction and operation. To the preparation of this statement on the environmental effects the following have contributed:

Doak C. Cox, Environmental Center and Department of Geology  
and Geophysics

Gordon Dugan, Department of Civil Engineering and Water  
Resources Research Center

Jerry M. Johnson, Environmental Center and School of Public  
Health

Frank Peterson, Department of Geology and Geophysics and  
Water Resources Research Center

Our statement does not represent an institutional position of the University.

At the request of the Office of Environmental Quality Control (OEQC) we began in July 1971 a review of the plans for the treatment plant and effluent disposal. On 14 September 1972 we submitted a report based on this review to Marvin Miura, who was then on the OEQC staff. To avoid repetition we will, from time to time, refer to that report for details.

Johnson had previously been involved with others in a study of the water quality of Kanaha Pond in the vicinity of the proposed treatment plant. Peterson, Cox, and others, had previously been involved in studies of underground injection possibilities in the vicinity. Cox has subsequently been involved in discussion of the sewage treatment and disposal plans and their implications with the County officials, their consultants in the preparation of the plans for the treatment plant and associated facilities, and representatives of the Maui Chapter of the Conservation Council for Hawaii which has been concerned with the effects of the plans on the Pond. Peterson has meanwhile been involved in plans for studying the effects of the intended underground injection of effluent from the proposed



plant. In the preparation of this statement we have had access to information supplied by the Maui Chapter of the Conservation Council for Hawaii in reports dated 19 December 1972 and 5, 6, and 30 January 1973.

In this statement we will address, first, the probable course of the effluent from the planned sewage treatment plant after injection in disposal wells proposed at the site adjacent to Kanaha Pond, second, the possible effects of the effluent on the water quality and ecology of the pond, third the possible effects of the effluent on the water quality and ecology of the coastal waters, fourth, some other environmental aspects of the proposed site, and fifth some environmental aspects of alternative sites.

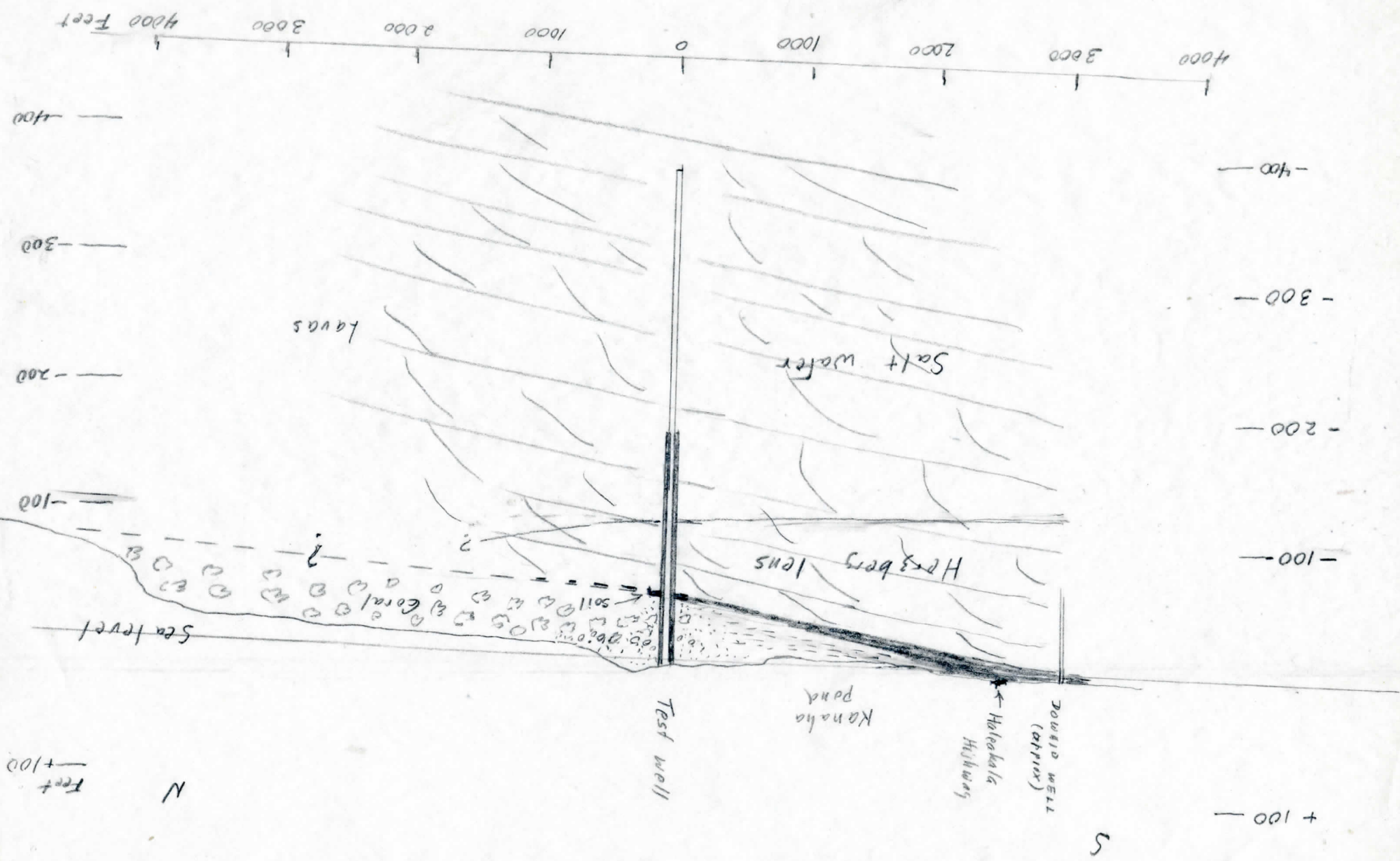
### Probable course of effluent

The effluent from the proposed secondary sewage treatment plant is intended to be injected underground in four disposal wells at the plant site between Kanaha Pond and the sea. Our discussion of the probable course of the effluent after it has been injected into the wells will be simplified by reference to a simplified sketch hydrogeologic section through the site, reproduced from our earlier report (Fig. 1). Bedrock in the area is comprised by Kula lava flows from Haleakala volcano. Overlying them, in the vicinity of Kanaha Pond, are a residual soil and coastal plain sediments. Offshore, the lavas are overlain by a coral reef, beneath which the residual soil may continue for some distance seaward from the shoreline. The lavas are, in general, highly permeable, and contain a lens of fresh to brackish groundwater to a depth of about 100 feet below sea level. Inland the top of the lens is a water table at about 2 1/2 feet above sea level. Beneath the Pond, however, the groundwater is artesian, being capped by the coastal plain sediments. Underneath the fresh to brackish water lens, the pores in the lavas are filled with salt water.

A pilot well has been drilled at the proposed sewage treatment site between Kanaha Pond and the sea, under the direction of the consultants to Maui County. This well is intended to be one of the four to be used for the underground effluent injection. The pilot well was drilled from a ground level of about 9 feet to a depth of 385 feet and cased to a depth of 180 feet (171 ft. below mean sea level). The other injection wells are intended to be constructed similarly. On the basis of the log and hydraulic tests of this well, the consultants have expressed their opinion that the effluent will be confined below a series of pyroclastic beds of low permeability interbedded with the lava flows, will spread over a large area, will be dispersed within salt-water bearing formations, will be naturally filtered, and will reach the ocean several miles offshore. For reasons detailed in our earlier report, we believe that there are no significant pyroclastics interbedded with the lavas. The injected effluent will be nearly fresh and hence much less dense than the salt water into which it will be injected. By buoyancy, therefore the injected effluent will rise through the salt water from the points of injection until it is incorporated in the lower portion of the fresh-brackish lens.

In our report we included a figure showing the rise of the injected water immediately around an injection well. However, the structure of the lavas, which include massive as well as permeable portions, is such that local horizontal deflections may be important, and the rise may be spread out or diverted

Figure 1. Sketch hydrogeologic profile through test well





several hundred feet. The deflections are likely to be essentially random in direction, but if there is any dominant direction to the horizontal component of upward flow it will be inland because of the seaward dip of the lavas.

The level at which the effluent will come to equilibrium in the lens depends upon the density profile of the water in the lens and the density which the effluent will assume as a result of its mixture with sea water in the course of its rise. No investigations have been made that indicate this latter density. Indeed, if the model Maui County consultants were correct -- the model involving pyroclastic aquicludes interbedded with the permeable lava flows, the horizontal component of the injected effluent would be inland, not seaward, because of the effect of buoyancy operating in the seaward dipping aquifers.

After it reaches the level of density equilibrium the flow of the effluent will be describable as the resultant of two essentially horizontal components; an induced component directed radially away from the injection well or wells and the natural flow component of the water in the lens. In general the natural flow is directed seaward, but in the vicinity of Kahului and Kanaha Pond the effect of the cap of coastal plain sediment is to divert the flow eastward to some extent. The distance to which the radial component of flow will carry effluent inland depends not only on the rate of effluent injection, but also critically on the seaward velocity of the natural flow component. No investigations appear to have been made to determine the seaward velocity. Indeed, as pointed out in our previous report, the hydraulic studies carried out as a basis for the design of the injection well system were poorly controlled and fail to indicate even such fundamental information as the head and hydraulic gradient of the lens in the vicinity of the wells and Kanaha Pond.

The groundwater of the lens naturally emerges at the shoreline and in shallow water, and the effluent will emerge there also. In no case can the emergence be deeper than about 100 feet below sea level (the approximate depth of the bottom of the lens) and it is probable that all significant emergence occurs at considerably smaller depths.

#### Possible effects on Kanaha Pond

In our address to the possible effects of the underground-injected effluent on the water quality of Kanaha Pond we will discuss, first, the pond hydrology, second the extent to which the effluent might reach the pond and, third, the effects if significant amounts of effluent do reach the pond. We will then present a summary of the expectable effects.

#### Pond hydrology

The pond is fed in part directly by rainfall, in part by surface runoff, in part by groundwater flowing essentially horizontally through the coastal plain sediments, in part by basal groundwater rising from the fresh-brackish lens in the lavas and, during drought periods, in part artificially by discharge from a well tapping the groundwater lens. The supply of water by direct rainfall is largely limited, and the supply by surface runoff is almost entirely limited, to storm periods. The permeability of the sediments is, in general, small, and



most of the groundwater in the sediments is probably derived by upward movement from the underlying lavas, although it is possible that a small amount is derived from excess irrigation water from nearby cane fields. Thus, the major supply of water to the pond except during storm periods must be expected on general grounds to be derived directly or indirectly from the underlying lens.

Losses of water from the pond occur by evaporation, by seepage through the beach ridge to the ocean, and by surface drainage. The seepage through the beach ridge is probably small, because of the low permeability especially of the organic sediments lining the pond itself. Surface discharges occur only during storm periods.

Johnson and others summarized certain hydrologic data pertinent to the pond water budget in their earlier work on the pond. The mean annual rainfall rate, estimated from the rainfall at Kahului Airport, is about 19 in. and the mean annual evaporation based on pan evaporation near Puunene, is about 90 in. Recognizing that much of the rainfall occurs during winter storms when the pond overflows and that some water is lost from the pond by seepage, it is clear that inflows to the pond must compensate for more than the 71 in/yr. deficit.

The Conservation Council Maui Chapter has provided additional hydrologic data based on the period August through October, 1972. Calculations based on this data are shown in Table 1. Over the period of measurement, the evaporation loss, estimated from pan data, averaged 0.309 in/day and the rainfall estimated from the airport record averaged 0.016 in/day, indicating a deficit of 0.292 in/day. During the same period the pond level dropped an average of 0.082 in/day leaving a balance of 0.210 in/day to be accounted for by net groundwater inflow. Over the 80-acre area of the pond this balance amounts to about 460,000 gallons per day excess of groundwater inflow over groundwater outflow. Although the Maui Chapter attempted to equate the pond-level drop with the groundwater outflow, there appears to be no basis for this, and all that can be said is that something on the order of 0.5 million gallons per day or more must be fed to the pond by groundwater during non-storm periods.

Differences in salinity indicated by samples collected by the Conservation Council Maui Chapter demonstrate convincingly that the major supply of water for the pond in normal weather groundwater is derived quite direct from the underlying basal lens via springs in the pond area.

During storms, the level of the pond rises and it discharges by surface overflow to the ocean.

#### Possible flow of effluent to pond

Although the pond is fed primarily by spring flow from the basal groundwater lens and, as shown previously, the effluent from the proposed sewage treatment plant will rise after injection in disposal wells to join the same lens, it does not follow that a significant part of the effluent will flow to the pond. The pond is very shallow, and the water flowing into it through springs is, therefore, derived from the freshest water at the top of the groundwater lens. The Conservation Council Maui Chapter found water at one inflow point containing only about 1800 ppm  $\text{Cl}^-$ , probably equivalent to about 3000 ppm total dissolved solids, although the salinity in the pond is generally much higher. The water

Table 1. Estimate of net groundwater inflow to  
Kanhaha Pond in normal weather

(Based on data from the Maui Chapter,  
Conservation Council for Hawaii)

<u>Period (dates)</u>	<u>Duration (days)</u>	<u>Evaporation (in.)</u>	<u>Rainfall (in.)</u>	<u>Drop in pond level (in.)</u>
1 Aug - 20 Sep 72	50	15.7	0.83	6.24
20 Sep - 11 Oct 72	21	6.6	0.68	0.36
11 Oct - 18 Oct 72	7	2.0	0.01	0.36
18 Oct - 1 Nov 72	14	4.1	0.00	0.60
Totals	92	28.4	1.52	7.56

Total evaporation 28.4 in.

Total rainfall - 1.5

Evaporation-rainfall 26.9 in.

Drop in pond level - 7.6

Unaccounted water loss to be accounted  
for by net groundwater inflow 19.3 in.

Pond area 80 acres

Net groundwater flow 1544 acre-in.

Period ÷ 92 days

Net groundwater inflow rate 16.8 acre in/day = 0.456 mgd



in the upper part of the lens must be at least as fresh as the inflow to the pond. Indeed the chloride content of the water yielded by the Kanaha Pond well, which extend to a depth of 85 feet, is only 530 mg/l (U.S. Geol. Survey Circular C62, 1972), probably equivalent to about 900 ppm tds.

Analyses of the Kahului and Wailuku sewage tabulated by the consultants to Maui County indicate tds concentrations of about 770 and 530 ppm respectively. The concentrations may be expected to be somewhat reduced by treatment. As pointed out earlier, however, this rather fresh effluent will become mixed with salt water in the course of its rise from the depth of injection to the lower part of the lens so that it will probably enter the lens with a tds content higher than that of the Kanaha well water and perhaps even higher than that of the freshest pond water. Thus the effluent mixed with salt water will probably come to equilibrium in the lower part of the lens.

As already indicated, because so little of the necessary information has been provided it is impossible to estimate how far the radial flow away from the injection wells will carry the effluent inland after it reaches its density equilibrium level in the lens. Part of the effluent may well be carried inland beyond the major springs feeding the pond. Even so the density stratification in the lens will greatly restrict the draft of effluent into the spring flow. It is extremely unlikely that the effluent will constitute a major part of the spring flow to the pond and it seems quite possible that no effluent will reach the pond by way of the springs. A more probable route by which some of the effluent may reach the pond is by way of the Kanaha Pond well, which taps water from the lower part of the lens. That well is used to supply the pond with water only during drought periods. Even by this route it seems unlikely that the effluent will constitute a major part of the pond water supply.

#### Possible effects of effluent in pond

We now address the concern that has been expressed with respect to the possible deleterious effects of the sewage treatment plant effluent on the flora and fauna of the Kanaha Pond Bird Sanctuary if the effluent does reach the pond. Chemical constituents of the effluent that might produce such effects would include biochemical oxygen demand (BOD), dissolved solid, nutrients, trace metals and trace organics.

BOD, a composite of oxygen-consuming organic and inorganic constituents is usually measured in a standard 5-day test, even though the 5-day BOD represents only about two thirds of the ultimate BOD. BOD may exert a detrimental effect on aquatic environments indirectly by depressing the dissolved oxygen (DO) concentration to a level below that at which aquatic organisms such as fish can survive. Thus the chemical parameter of direct concern is dissolved-oxygen whereas BOD is of concern indirectly in that it removes dissolved-oxygen from the water. The BOD concentration in the effluent from a secondary treatment such as that proposed for Wailuku-Kahului would be expected to be less than 20 mg/l. Some BOD removal should be expected through filtration in the aquifer. The concentration left should have no significance in the effects of the greatly diluted part of the effluent which might reach the pond. The groundwater feeding the pond probably lacks significant DO, and it passes through high organic sediments in the pond bottom. Oxygenation processes in the pond must clearly be



adequate to compensate for the oxygen deficiency and natural BOD contributions far greater than those which could be derived from the effluent.

Dissolved solids consist primarily of calcium, magnesium, sodium, potassium, carbonates, bicarbonates, chlorides, sulphates, nitrates, phosphates, and possibly some other minor chemical constituents. Their total concentration (TDS) exerts an influence on aquatic organisms through the osmotic pressure it creates in the water. Organisms vary in their adaptability to different osmotic pressures and their rate of adaptation to osmotic pressure fluctuations.

TDS concentrations in Kanaha Pond vary tremendously in both space and over time. Organisms living in that environment have to have great adaptability, considering they have been able to successfully live and reproduce. Therefore, no adverse biological effects should be expected from the TDS entering the pond through groundwater infiltration, even if the TDS concentration were raised slightly by the entrainment of some effluent from the sewage treatment plant.

The nutrients of greatest importance would be available nitrates and phosphates. They exert influence over aquatic environments by their fertilizing effect. In other words as their concentrations increase, up to some maximum level, they stimulate an increase in organismic growth or productivity. As productivity increases, chemical, physical and biological changes occur which are detrimental to organisms living in the ecosystem prior to the stimulation of higher rates of productivity. Examples of such changes are increased turbidity and reduced DO. These interrelated changes due to nutrient enrichment are called eutrophication. With respect to Kanaha Pond, a high level of productivity is already present. Therefore, the immediate productivity stimulating effects of nitrogen and phosphorus, if these nutrients reached the pond at some level of dilution from the sewage effluent, should be minimal or non-existent.

There could possibly be a long-term gradual accumulation of nitrogen and phosphorus. Their rates of course would depend upon the amounts of each contributed over time from sewage contamination. The significance of these accumulations in relation to the total pool of nitrogen and phosphorus although difficult to assess should be minor. It is possible that pond overflow during storm conditions would remove a portion of the pond's nitrogen and phosphorus pools and thus negate any accumulatory effects arising from sewage contamination.

Trace metals would be of concern because of their possible toxic effects to aquatic populations. These substances would include arsenic, cadmium, copper, chromium, lead, mercury and zinc and their salts. At certain concentrations some of these metals, cadmium, copper, chromium, lead and zinc, are metabolic requirements of some aquatic organisms and at higher concentrations they can become toxic. The threshold of toxicity for all of these trace metals is extremely variable; depending upon the element and its chemical form, the organism of concern and the chemical and physical water quality of the environment within which it lives. Thus it is difficult to generalize about the possible toxicity of these elements and their salts on the flora and fauna of Kanaha Pond and the in-shore ocean area. The California State Water Resources Control Board in its 1971 "Water Quality Criteria" document has provided data on trace metal toxicity to fish and wildlife. In Table 2 we list the minimum concentration at which each of the metals has been demonstrated to be toxic to



aquatic life from the document; the approximate concentrations of these metals in the effluent from the proposed plant; average trace metal levels found in samples of Kanaha Pond sediments during a 1972 University of Hawaii study; and finally average sea water trace metal concentrations. Trace metal concentrations found in the Sand Island and Mililani Town sewage discharges are below the lowest concentrations reported to be toxic to aquatic organisms in the 1971 California "Water Quality Criteria" document. In addition, the sewage effluent, if it did reach the pond, would be greatly diluted so that acute toxicity problems would seem unlikely.

A well known phenomenon occurring in relatively closed aquatic ecosystems such as ponds and lakes is the entrapment or accumulation of chemical substances entering them. Thus it would be possible for trace metals entering the pond from sewage effluent contamination to gradually accumulate over time in the pond water and sediment. The metals could then be concentrated within the tissue of the pond flora and fauna. However, the high level of average trace metal concentrations already observed in the pond sediment (Table 2) indicates that large trace metal pools already exist. Thus the sewage effluent, if it did reach the pond at some much reduced concentration should have a negligible effect contributory to that of the already existing trace metal pools.

Table 2. Trace metal concentrations of significance

substance	lowest concentration demonstrated toxic to fish and aquatic life <sup>2</sup> ppm	ave. levels in sewage plant effluent ppm	ave. levels in Kanaha Pond sediment <sup>1</sup> ppm	ave. levels in sea water <sup>5</sup> mg/l
Arsenic	0.7	0.00019 <sup>4</sup>	---	0.003
Cadmium	0.01	0.048 <sup>3</sup>	3.53	0.00011
Chromium	0.016	---	---	0.00005
Copper	0.015	not detectable <sup>4</sup>	20.47	0.003
Lead	0.1	0.035 <sup>3</sup>	30.42	0.00003
Mercury	0.004	<0.0003 <sup>3</sup>	0.178	0.00003
Zinc	0.01	0.00080 <sup>4</sup>	55.0	0.01

<sup>1</sup>University of Hawaii Kanaha Pond Baseline Study, 1972

<sup>2</sup>California Water Quality Criteria, 1971

<sup>3</sup>Sand Island discharge (raw sewage)

<sup>4</sup>Mililani Town discharge (extended aeration)

<sup>5</sup>The Sea Vol. 2, 1965. M.N. Hill Gen. Ed., Interscience: N.Y.

Concerns with trace organic chemicals would be similar to those with trace metals. The organic substances of concern would include, but not necessarily be limited to DDT, Dieldrin, Lindane and pentachlorophenol (PCP). Some of these substances are toxic at very low concentrations (Table 3). In addition, less is known about the existing average levels of these substances within the pond (Table 3). However, the average concentrations of trace organics found in effluent from the Mililani Town extended aeration plant (Table 3) would indicate that acute toxic problems in Kanaha pond would seem unlikely. The possibility of trace organic accumulation and biological concentration within the pond is a remote possibility. Although we have little information about the existing pools of organics, evidence suggests they are present in the pond at low concentration. Therefore, long-term accumulation and bioconcentration of trace organic imports could have adverse effects on the pond's biota.

Table 3. Trace organic concentrations of significance

	lowest concentration demonstrated toxic to fish and aquatic life <sup>1</sup> ppb	ave. levels in sewage plant effluent <sup>2</sup> ppb	ave. levels in Kanaha Pond <sup>3</sup> ppb	
			Sediment	Water
DDT	1.	0.01	0.265	0.0062
PCP	56.	0.91		0.031
Dieldrin	7.	0.002		
Lindane	10.	0.146		

<sup>1</sup>California Water Quality Criteria, 1971

<sup>2</sup>University of Hawaii Kanaha Pond Study, 1972

<sup>3</sup>Mililani Town discharge (extended aeration)

#### Summary

The possibility that the effluent from the sewage treatment plant might have significant effects on the water quality and ecology of the Kanaha Pond can be summarized as follows:

1. The pond is fed from the same groundwater lens as that to which the effluent will flow. However, the effluent will recharge the lower part of the lens while the pond is fed primarily from the upper part of the lens. The density structure of the lens is such that little or no effluent is likely to reach the pond. The greatest chance of significant amounts of effluent reaching the pond is by way of the Kanaha Pond well. The effluent would be greatly diluted if it reached the well which, in any case is only used during drought periods.



2. If the effluent were to reach the pond full strength without dilution it is possible that serious ecological effects would result.

3. However, it is unlikely that significant ecological changes will result from such greatly diluted effluent as might perhaps reach the pond.

#### Possible effects on coastal waters

Concern over the ecological effects of the sewage treatment plant effluent injected near Kanaha Pond should not be restricted to effects in the pond. In the flow model assumed by the consultants to Maui County, the effluent would reach the ocean only well offshore and at great depth. However, as discussed both earlier in this statement and in our previous report, the effluent will emerge in very shallow water very close to shore. For reasons detailed in our earlier report, we believe that there will be considerable dilution of the effluent by the time it emerges, but quantitative estimation of the dilution is at this point impossible. The nutrients in the effluent should probably be of greatest concern because of the stimulation of algal growth. Such stimulation has apparently resulted from the discharge of sewage effluents in near-shore waters through short outfalls. Considering the possible ranges of dilution of the injected effluent from the Kahului-Wailuku plant, the diluted effluent might conceivably contain nutrient concentrations several times the natural concentration in the ocean or only a small fraction of the natural concentrations.

We summarized the situation in our earlier report as follows: "The effects of the diluted effluent in the sea water do not seem likely to be significant. However, in the light of the great concern over meeting coastal water standards, the assumption of insignificant coastal water quality effects implicit in the recommendation of underground injection is an indication of an 'out of sight, out of mind' philosophy which has been stimulated by the restriction of the standards to surface and coastal waters excluding groundwater."

#### Other environmental aspects

##### Tsunami hazard

In our previous report we called attention to the hazard of tsunami inundation at the proposed Kanaha Pond site for the sewage treatment plant. We called attention to the fact that the land fill that was planned would not constitute adequate protection against the hazard, but recognized that with suitable design the plant could be made essentially tsunami proof. We understand attention has been given to such design.

##### Beach retreat

We did not, in our previous report, call attention to the hazard of beach retreat at the proposed site, but were subsequently reminded of this hazard by representatives of the Maui Chapter of the Conservation Council.

The beaches along most of the coast from Kahului to Paia have been retreating for many decades. Some years ago it seemed that the rate of sand loss from this beach system was very nearly equal to the rate of sand mining for lime manufacture, road surfacing, and mixing in concrete suggesting that the mining might be the cause of the retreat. Whether or not sand mining is still practiced on this coast, the beaches are still retreating, and the configuration of the beach in the vicinity of Kanaha Pond suggests that the recent retreat has been particularly severe in that vicinity.

If beach retreat threatens the sewage treatment plant, it can, of course, be protected, but attempts to provide artificial protection against beach retreat have very frequently had unfortunate consequences on beach stability in nearby areas.

### Alternative sites

Comments on certain environmental aspects of two alternative sites that have been considered for the Kahului-Wailuku sewage treatment plant seem appropriate.

#### West Kahului site

One of these sites is near the root of the west breakwater of Kahului Harbor. We think it should be noted that underground injection of effluent at this site may be quite infeasible. Successful injection of effluent at the Kanaha Pond site is made possible by the presence of lava flows from Haleakala underlying the site at small depth. Near the west end of Kahului Harbor the Haleakala lava flows pinch out and interfinger with alluvium from West Maui. Although Haleakala lavas are present near the surface at the Maui Pineapple cannery, no lava flows were encountered at the Maui Community College well no. 17.2 to a depth of 68 feet or at Maui County well no. 17.1 to a depth of 110 feet, both near the west end of Kahului Harbor (U.S. Geol. Survey Circ. C-62, 1972). At the Wailuku Mill a test hole drilled about 30 years ago extended to a depth of 600 or 700 feet below sea level without encountering either lavas from Haleakala or lavas from West Maui. The permeability of the sediment interfingered with the Haleakala lavas in the vicinity of the west part of Kahului Harbor is much too low to permit successful injection of sewage. No plans should be made to inject sewage in this area without test drilling to demonstrate the presence of lavas at the site.

#### Airport site

The other site to be considered is in the sand dunes east of Kanaha Pond and northwest of Kahului Airport. Although there are beach and dune deposits at the surface in part of this area, the same lavas that are found at Kanaha Pond lie close to the surface. Hence underground injection should be equally feasible there. There are no ponds in the vicinity so there would be no question of ecological effects in such ponds. The sewage treatment plant could be located on higher ground farther back from the shore than at Kanaha Pond, reducing the hazards from tsunamis and beach retreat. The major disadvantages with this site are non-environmental ones such as the greater distance that the sewage would have to be transported.



## Conclusions

As will perhaps have been recognized from the discussion in the body of the statement and in our previous report, we believe that the investigation which led to the selection of the Kanaha Pond site for the Wailuku-Kahului sewage treatment plant and to the selection of underground injection as the means for disposal of the effluent of the plant has in many ways been inadequate and in some ways been misleading. We believe that plans based on more thorough and valid investigations might differ in some respects from those now being considered. However, we would not like to leave the impression that, in our opinion, the construction and use of the plant as it is now planned should be deferred. Deferral would mean continuance of the present practice of discharging raw sewage to near-shore waters both east and west of Kahului Harbor for the period sufficient for thorough reexamination, and for the development of new plans if a change in site or means of effluent disposal seemed in order. It is our understanding that a favorable bid has been received for construction in accordance with the present plans. Stronger evidence than is now available to us that significant deleterious ecological effects will result from the implementation of the present plans would have to be available to lead us to believe that deferral would be warranted.

We do, however, recommend that plans being developed for more thorough investigation of the course of flows injected in the proposed wells as a preliminary part of the construction program be completed and implemented, so that, if construction proceeds, the effects of injection can be monitored after the facilities are put in operation and, indeed, so that even at a later date the major part of the construction program could be cancelled, if early information from this investigation warranted such drastic action.